



# Site Policies and Procedures

<b>Use of COUPP Radiation Sources</b>		
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## 1.0 PURPOSE

The purpose of this procedure is to establish the requirements for the safe storage and handling of sealed radioactive isotopes, Cobalt-60 (Co-60) and Barium 133 (Ba-133), for the purpose of calibrating the COUPP experiment. This sets out the procedure to minimize the radiation exposure of personnel using these sources.

## 2.0 GENERAL INFORMATION

2.1 Radioactive sources used at SNOLAB must be:

- a) licensed by the Canadian Nuclear Safety Commission under the Nuclear Safety and Control Act - Section 44, SOR/2000-207;
- b) approved by the SNOLAB Director; and
- c) used only by personnel that have been trained and authorised as source users by the SNOLAB Radiation Safety Officer.

2.2 Personnel working at SNOLAB are classified as non-Nuclear Energy Workers. The radiation dose limits for non-Nuclear Energy Workers are:

- Whole-body dose = 1milliSievert/year.
- Extremity/Skin dose = 50 milliSievert/year.

To ensure that any radiation exposure to personnel is kept as low as

reasonably achievable SNOLAB has established a Radiation Protection Program. The Radiation Protection Program also helps to ensure that the low background radiation environment at SNOLAB is not compromised.

- 2.3 Calibration of the COUPP experiment requires the use of two gamma radiation emitting sources that require special handling instructions. The two radioactive sources to be used are:

- a) A 0.1 millicurie Cobalt-60 source with a calculated dose-rate of 1.0 microSievert/hour at 1 metre, without shielding; and
- b) A 1.0 millicurie Barium-133 source with a calculated dose-rate of 1.3 microSievert/hour at 1 metre, without shielding.

Both sources are triple-encapsulated in stainless steel and stored inside individual lead-pigs to reduce radiation exposure. The Cobalt-60 source produces highly penetrating gamma rays, so extra care should be taken when transporting or using this source, even when shielded, in order to reduce the received dose.

Radiation dose exposure for authorised personnel that transport and use the COUPP sources will be calculated by using measurements taken with a portable gamma monitor, and the recorded time periods of exposure.

The application of safe radiation protection practices (minimize time, maximize distance, and maximize shielding) is required when handling these sources to keep dose exposure as low as reasonably achievable.

### 3.0 STANDARD PRACTICES

#### 3.1 General Practices

- i. Safe radiation protection protocols are required of all personnel using these two COUPP gamma sources.
- ii. The COUPP gamma sources will only be used or transported by personnel that have been trained and authorised by the Radiation Safety Officer.
- iii. The COUPP gamma sources will be stored in the SNOLAB source storage cabinet, located inside the SNO+ Control Room. Any source removed from the storage cabinet must be signed out using the source accountancy log, and signed back in when the source is

returned. The source storage cabinet is locked, access for authorised source users shall be arranged with the Radiation Safety Officer.

- iv. During transport the sources will be placed on a trolley to help minimize any radiation exposure to personnel.
- v. If damage of the source encapsulation is suspected:
  - a. Barrier off the affected area immediately with rope or chain.
  - b. Inform the Laboratory Response Coordinator and the Radiation Safety Officer of the incident, and
  - c. Follow SNOLABP-Monitoring and Responding to Radioactive Contamination.
- vi. Do not touch these sources directly with your hands; always use remote handling devices including tongs, wrenches, and source holders.
- vii. Handle the sources at least at arm's length whenever this is possible. Distance significantly lowers radiation exposure. Do not loiter near these sources.
- viii. Always keep the sources in their lead containers, except when they are being used for the calibration of the COUPP experiment.
- ix. Sources shall only be left unattended, during storage in SNOLAB'S source store, or when installed for experimental calibrations in accordance with this procedure.
- x. Use tongs to lift the source's pig, or to open the lid of the pig.
- xi. The Ba-133 source is shielded inside a three-quarter inch (3/4") lead-pig weighing 4Kg (9lb), and the Co-60 source is shielded inside a 1 inch lead-pig weighing 6.5Kg (14.5lb). Therefore, safe lifting and manual handling techniques are required. If necessary perform a two-man lift to avoid dropping or damaging the sources.
- xii. If you suspect that either of these sources has been lost, or stolen, inform the Laboratory Response Coordinator and Radiation Safety Officer immediately.

### **3.2 Source Installation**

- i. Place a ladder next to the COUPP shield; ensure that the source hole is accessible.
- ii. Locate the COUPP gamma source holder next to the water shield. Adjust the source holder to the desired length.
- iii. Install a radiation hazard warning sign (see Appendix A on the exterior of the experiment indicating the presence of a radiation hazard and warning staff not to loiter in the area). Laminated copies of this sign are available in the COUPP work procedures manual at the COUPP experiment site.
- iv. Install the appropriate radioactive source sign next to the source hole of the COUPP shield, indicating which radioactive source is currently installed. Prepared signs are available in the COUPP work procedures manual at the COUPP experiment site.
- v. Proceed to the SNOLAB source storage cabinet. Locate a portable gamma radiation measuring instrument, to measure and record dose rates during installation of the source. Verify the gamma meter using one of the SNOLAB check sources.
- vi. Log the source out of the source store using the source accountancy log.
- vii. Place the source on a trolley, to minimize radiation exposure while transporting the source and portable radiation monitor to the experiment. Use tongs when lifting the source's pig.
- viii. During transport of the sources give verbal advice to personnel to maintain a distance of 1.5metres from the trolley.
- ix. Find a location next to the water shield in which to work. To minimize radiation exposure, ensure that other workers are aware of the radiation hazard and that they keep a safe distance of at least 1.5 metres away from the installed source.
- x. Use a portable gamma radiation measuring instrument, to measure dose-rates and the time period of exposure during transport and

installation of the source. Record the measurements in the COUPP radiation log-book.

- xi. Use a pair of tongs to lift the lid of the lead pig.
- xii. Use a long- handled ½ inch open wrench to hold the source, while screwing in the source holder. Hold the source holder near its top. Ensure that the holder is bottomed in the source encapsulation's threads.
- xiii. Using the source holder to maintain distance, lift the source out of the pig, climb the ladder and insert the source into the source hole. Slowly lower the source until the holder rests in the hole.
- x. Place the empty lead-pig, with the lid open, on top of the shield next to the source hole and replace the ladder. Return the portable radiation monitor to the source storage cabinet and record the dose received during transport and installation of the source in the SNOLAB and COUPP radiation log-books.

### **3.3 Source Removal**

- i. Obtain a portable gamma radiation measuring instrument to measure and record dose-rates during the removal and return of the source.
- ii. Place a ladder next to the COUPP shielding and ensure that the source hole is accessible.
- iii. Find a location next to the water shield in which to work.
- iv. Ensure that any other workers in the area are aware that you will be moving a radioactive source and check that they are stationed at least 1.5 metres away from you, to reduce radiation exposure.
- v. Place the empty lead-pig in the work area, on its cart, with the lid open ready to accept the source, and a pair of tongs ready for closing the pig's lid.
- vi. Lift the source holder out of the source hole.
- vii. If the source snags, use no more than 20lbs. of force when attempting to unsnag it.

- viii. Carry the source to the lead-pig, using the holder to maintain distance. Once inside the pig, use a long-handled half-inch ( $\frac{1}{2}$ " ) wrench to hold the source while unscrewing the holder.
- ix. Use a pair of tongs to place the lid on the lead pig.
- x. Replace the plug from the source hole back in the source hole, and remove the radiation hazard warning signs.
- xi. Using the trolley return the source to the SNOLAB source store. Give personnel verbal advice to maintain a distance of 1.5 metres from the trolley.
- xii. Sign the source back in to the source accountancy log and place it back in the source store.
- xiii. Return the portable radiation monitor, and record the dose received in the SNOLAB radiation log-book and the COUPP radiation log-book.
- xiv. Remove the ladder and the radiation warning signs at the COUPP experiment site.

#### 4.0 SUPPLEMENTARY INFORMATION AND REFERENCES

Nuclear Safety and Control Act – Section 44 – SOR/2000-207  
SNOLABP-Radiation Protection Program  
SNOLABP-Training and Authorization for Users of Radioactive Sources  
SNOLABP-Monitoring and Responding to Radioactive Contamination  
SNOLABP-Radioisotope Storage

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#### REVISION HISTORY:

REVISION NUMBER	DATE (YYYY-MM-DD)	AUTHOR	CHANGES

Appendix A. Radiation Hazard Sign

